CLAIMS

[0050] What is claimed as new and desired to be protected by Letters Patent of the United States is:

1. A system for detecting explosives and controlled substances in an object, comprising:

   a source/detector array comprising a plurality of sources and a plurality of detectors;

   a signal processor coupled to the source/detector array for processing data received from the detectors;

   a classifier coupled to the signal processor for classifying data received from the signal processor according to a plurality of algorithms;

   a maximal rejection classifier coupled to the classifier; and

   a declarative decision module coupled to the maximal rejection classifier for rendering a decision regarding the contents of the object.

2. The system of claim 1, further comprising an operator module coupled to the signal processor.

3. The system of claim 2, wherein the operator module is coupled to the declarative decision module.

4. An apparatus for detecting explosives and controlled substances in an object, comprising:

an enclosure;

a shield layer disposed within the enclosure;

a cavity disposed within the shield layer, said cavity comprising one or more turns which preclude a straight line trajectory through the cavity;

a source/detection array disposed within the cavity; and

a transport mechanism for moving objects through the cavity and past the source/detection array.

5. The apparatus of claim 4, wherein the shape of the enclosure is rectangular.

6. The apparatus of claim 5, wherein the dimensions of the enclosure are no more than about 6 meters in length, about 3 meters in width, and about 3 meters in height.

7. The apparatus of claim 4, wherein the shape of the enclosure is selected from the group consisting of rectangular, circular, triangular, and square.

8. The apparatus of claim 4, wherein the shield layer precludes gamma radiation from leaving the enclosure.

9. The apparatus of claim 4, wherein the shield layer comprises water, wherein the water is contained between the enclosure and the cavity.

10. The apparatus of claim 4, wherein the cavity has an opening at each end.

11. The apparatus of claim 4, wherein the ends of the cavity are disposed on opposite sides of the enclosure.

12. The apparatus of claim 4, wherein the cavity further comprises at least three connected segments.

13. The apparatus of claim 12, wherein at least two segments of the cavity are connected to at least another segment at an angle of less than or equal to 90 degrees.

14. The apparatus of claim 12, wherein at least two segments of the cavity are connected to at least another segment at an angle of greater than 90 degrees.

15. The apparatus of claim 4 wherein the shape of the cavity is selected from group consisting of rectangular, circular, triangular, and square.

16. The apparatus of claim 4, wherein the detection array is disposed around the transport mechanism.

17. The apparatus of claim 16, wherein the detection array further comprises a plurality of neutron sources and a plurality of gamma detectors.

18. The apparatus of claim 17, wherein the array is arranged such that an equal number of neutron sources are disposed on at least two sides of the array.

19. The apparatus of claim 17, wherein the array is arranged such that an equal number of gamma detectors are disposed on at least two sides of the array.

20. The apparatus of claim 17, wherein the plurality of neutron sources are low intensity neutron sources.

21. The apparatus of claim 17, wherein the plurality of neutron sources comprises at least 10 neutron sources.

22. The apparatus of claim 17, wherein the plurality of gamma detectors comprises at least 100 gamma detectors.

23. A method of detecting explosives and controlled substances in an object, comprising:

transporting the object through a cavity in a shielded apparatus, said cavity comprising one or more turns which preclude a straight line trajectory through the cavity;

generating low intensity neutron particles from a plurality of neutron sources;

irradiating the object with the neutron particles wherein the object generates prompt gamma rays;

detecting the prompt gamma rays with a plurality of gamma ray detectors;

analyzing the gamma counts associated with the explosives or controlled substances in the object; and

determining whether an explosive or controlled substance is present in the object when the relative atomic percentages of elements comprising the controlled substances are substantially similar to the relative atomic percentages of elements associated with known explosives and controlled substances.

24. A method of detecting explosives and controlled substances in an object, comprising:

detecting the back scattered gamma rays emitted by all substances contained within the object in response to the irradiation;

determining the gamma counts with a plurality of gamma ray detectors;

isolating the common eigen value signatures of the substances contained within the object; and

using a maximal rejection hierarchy classifier to determine if a controlled substance is present in the object without interference by the presence of a confounding substance.

25. The method of claim 23, wherein the cavity is surrounded by water.

26. The method of claim 23, wherein the low energy neutron particles comprise 14.7 MeV neutrons with an energy density of 10^7 neutrons/sec.

27. The method of claim 23, wherein the neutron particles are generated by pulsing the neutron sources simultaneously.

28. The method of claim 27, wherein the neutron sources are pulsed sequentially after the presence of an explosive or controlled substance is detected with a scan of simultaneously pulsed neutron sources.

29. The method of claim 23, wherein the object is irradiated a first time and at least a second time.

30. The method of claim 29, wherein the neutron particles are generated by pulsing the neutron sources simultaneously at the first time.

31. The method of claim 30, wherein the neutron particles are generated by pulsing the neutron sources sequentially at the at least a second time.

32. The method of claim 23, wherein the plurality of neutron sources comprises at least 10 neutron sources.

33. The method of claim 23, wherein the plurality of neutron sources are low intensity neutron sources.

34. The method of claim 23, wherein the plurality of gamma ray detectors comprises at least 100 gamma ray detectors.

35. The method of claim 23, wherein the neutron sources are arranged in an array in close proximity to the object.

36. The method of claim 35, wherein the array is arranged such that an equal number of neutron sources are disposed on at least two sides of the array.

37. The method claim 36, wherein each neutron source irradiates a predetermined area of the object.

38. The method claim 35, wherein the array further comprises the plurality of gamma ray detectors.

39. The method of claim 38, wherein the plurality of gamma ray detectors comprises gamma ray detectors.

40. The method of claim 39, wherein the array is arranged such that an equal number of gamma ray detectors are disposed on at least two sides of the array.

41. The method of claim 35, wherein the cavity further comprises a transport mechanism for moving the object through the cavity.

42. The method claim 41, wherein the array is disposed inside the cavity and the object passes through the array as the transport mechanism moves the object through the cavity.

43. The method of claim 23, wherein the elements comprising the controlled substances are selected from the group consisting of carbon, oxygen, nitrogen, and chlorine.

44. The method of claim 23, wherein the controlled substances are selected from the group including TNT, PETN, RDX, HMX, Ammonium Nitrate, Plutonium, Uranium, and drugs.

45. The method of claim 44, wherein the energies of gamma counts associated with carbon, oxygen, nitrogen, and chlorine are 4.43 MeV, 6.14 MeV, 2.31 MeV, respectively.

46. The method of claim 23, further comprising determining whether a confounder is present in the object when the relative atomic percentages of elements comprising the controlled substances are substantially similar to the relative atomic percentages of elements associated with known confounders.

47. The method of claim 46, wherein the confounders are selected from group consisting of nylon and food.